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## Sustainability certification of neighbourhoods

*Experience from DGNB New Urban Districts in Denmark*

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## Nordregio News

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### Planning Tools for Urban Sustainability

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# New Technologies, New Tools for Sustainable Planning

Cities are complex assemblages of people, houses, roads, bridges, subways, cars, parks, animals, pipelines, wireless networks, phones, cameras and so on. While technological developments have significantly contributed to this complexity, they also offer new solutions for future urban developments. In this issue of Nordregio News, researchers explore new technologies and new tools for sustainable urban planning. From different perspectives the three articles provide new insights on innovative planning tools and models for managing complexity at different scales.

In the first article, **Urban Form and Sustainability: the Planner's Toolbelt**, Ryan Weber, Lars Berglund and Christian Fredricsson emphasize the benefits of integrated approaches to planning. Through new sophisticated technologies and models more and more factors can be considered simultaneously, which can provide more accurate future predictions of different planning strategies and policies. Innovative integrated modeling systems also include new visualisations which can help in collaborative decision making processes.

Urban models are usually used at the city-regional scale but there are also new and ready to use planning tools at a more local scale. In the second article, **Sustainability Certification of Neighbourhoods: Experience from DGNB New Urban Districts in Denmark**, Jesper Ole Jensen, discusses the Danish experiences of sustainability certification as a planning tool. The pilot testing of these schemes are promising, but their future implementation is dependent on institutional support from public authorities and acceptance and diffusion from

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actors within the development industry. During the last decades many modeling systems and certification schemes have been developed which are now available for planners and policy makers to use, but there are also a resurgent research interest in developing new models using new technologies.

How to take planning models to the next level by taking advantage of new technologies, is discussed by Joan Serras, Melanie Bosredon, Ricardo Herranz, and Michael Batty in the final article; **Urban Planning and Big Data – Taking LUTi Models to the Next Level?**. They argue that the big data, i.e. unstructured and dynamic data difficult to fit into simple tables and charts; which is constantly been collected through new technologies and social media, has huge potentials, but that there is still a lot of technical challenges regarding computing and visualization. It might also be added that the new technologies also present ethical and political challenges, both with regard to the use (or miss-use) of data (and data-collection) and implementation within planning practices. In the end the crucial question is how we choose to use (or not use) the new opportunities provided by these technological advantages to foster inclusive and sustainable urban development.

How urban planning can contribute to create sustainable and attractive urban areas is also the main topic of the **Nordic working group on green growth: sustainable urban regions**. During the current program period 2013-2016, the working group will further explore this topic and different tools of how urban and regional planning can support green growth and simultaneously manage important challenges such as demographic transformation, social inclusion, climate change. The working group has a focus on the fast growing urban areas within the Nordic countries where these challenges particular articulated and manifested.

We hope you enjoy reading this issue of Nordregio News!



**Lukas Smas**

Senior Research Fellow  
and the Editorial Board of Nordregio News

# Urban Form and Sustainability: the Planner's Toolbox

*By Ryan Weber, Lars Berglund & Christian Fredricsson*

Planners and policymakers face the difficult task of working in a complex, interconnected and ever-changing world. They face challenging decisions regarding the design of policies for sustainable development, because the integrated management of different types of land use involves systems in which natural and human factors are closely interconnected. This includes the struggle to balance the demands of growth with the desire to preserve the natural environment and other quality-of-life attributes - all while ensuring that the interests of many actors are acknowledged and accommodated.

In a Nordic context, the physical planning domain is endowed with a significant degree of control over development of the urban form, because a strong tradition of comprehensive planning is evident. As a result, the overall aim of successful land-use planning should be for land to be used for the purpose to which it is best suited, and policies should be designed to minimise possible negative externalities and impacts on the environment and society. The result is that physical planning can exert significant control over land change processes through restrictions on development in some areas and stimulating development in others. This is often in contrast to planning in North America, where market-driven processes tend to prevail.

Discussions concerning the norms of urban planning that act as a back-drop for physical planners continue alongside the evolution of social, economic and spatial patterns. An important aspect of these discussions over the past 25 years concerns the inefficiency of low-density urban sprawl and the resource efficiency of proposed solutions, including strategic densification and compact city development. The discussion includes the expanding number and quality of tools that are available for urban planners to reconcile urban development with environmental objectives. This topic has been an important focus of Nordregio's and WSP's joint work within the **Nordic working group on green growth – sustainable urban regions**, where specific emphasis has been placed on the use of integrated land-use models.

Many types of tools and methods are available to assist planners and policymakers in a variety of ways. Some, such as impact assessments, are legally mandated. Others, such as life cycle analyses, certification schemes, eco-labelling or GIS mapping and monitoring, are



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voluntary. In one way or another, these are used to structure the work of planners. They provide clearer statements of existing problems and possible solutions, legitimise sustainability efforts, motivate investment, document plans and achievements and include new participants in decision-making processes. As the author of the next article eloquently stated a number of years ago, planning tools are based on the view that what gets measured and monitored gets managed, therefore increasing the likelihood of strategic goals being achieved.

### Urban form and sustainability

More than any other issue, improving the environmental sustainability and attractiveness of our cities comes down to how and where to build buildings. In terms of 'how', the buildings constructed thus far require far too much energy to sustain our activities. While we did not have nearly the same level of knowledge of the environmental impacts of fossil fuel consumption 40 years ago, the fact remains that Europeans consume more than 40% of their total energy demand in buildings, which is approximately 13.4 billion barrels of oil per year.

In terms of the 'where', however, buildings continue to be built in the wrong places – in locations that create too much importance for the private car as the dominant form of transport. Contemporary urban sprawl is the result of a market-driven process, proliferated by cheap energy and the rapid growth of private cars as a symbol of wealth and an affordable means of transport during the first half of the 20th century. Urban planning and design adjusted quickly to the demand for car infrastructure required by suburban living and unrestrained land acquisition from agricultural areas, forests and other open spaces that became the norm as extensive road networks were constructed. The availability of the car meant that land-use functions could be separated by single-use zoning, precipitating even lower residential and job densities and making the private car the only rational means of transportation.

Two alternatives to urban sprawl are the interrelated concepts of strategic densification and compact city development, which foster a more sustainable urban form through relatively high residential density and mixed land uses. In a perfect world, this would produce urban spaces that were much more resource efficient because walking, cycling and public transport would be the most attractive options for moving about in everyday life – between home, work and school, and for recreation and shopping. To give an appreciation of the real-world connection between urban form and transport, the table below shows a clear correlation between the density of residential buildings and the attractiveness of non-car forms of transport. While the private car is necessary for almost 70% of daily trips in a low-density residential setting, this is reduced to just over 20% for typical inner-city residential blocks.

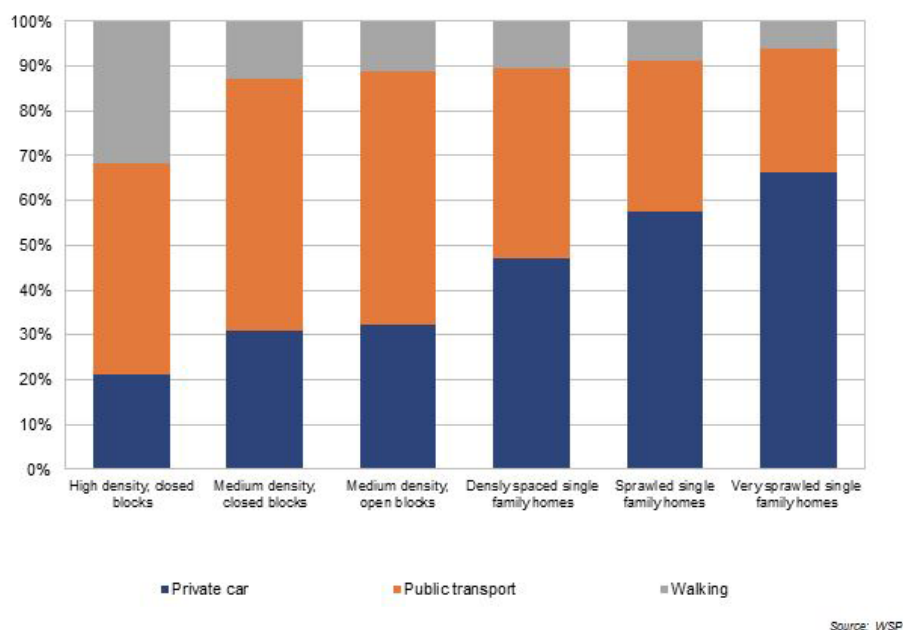


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Modal split and building density – observed data in the Stockholm region in 2006



## Integrated approaches to planning

Assessment of a plan's impact has historically often been an intuitive process, based on planners' experience and qualitative considerations. Very often, it has been difficult to quantify the impact of various planning strategies and policies in terms of land use, accessibility and environmental impacts in a coherent manner. In addition, planning specialists (e.g. transport planners and land-use planners) have typically designed different parts of the plan and assessed the possible impacts separately within their own fields, resulting in a lack of true integration between planning fields. Historically, this can partly be explained by a lack of appropriate planning tools.

The importance of integrating land use and mobility issues is reflected by the City of Vancouver's former Planning Director Brent Toderian who rightly states: *"The best transportation plan is a great land use plan."* Taken a step further, the latest book from Michael Batty, who contributed to the third article in this issue, opens by discussing how we still, too often, think of cities singularly in terms of places and spaces that are stitched together by transportation. This is in contrast to the opinions of a wide-ranging group of important urban thinkers – such as Jane Jacobs, Peter Hall, Manuel Castells and others – who in their own ways describe how cities are most importantly defined and planned based on the relationships, networks and flows from which locations emerge.

Even when the public recognises the importance of integrating the transport and building dimensions of urban planning, planners must

still consider many land-use issues to achieve good city building, particularly in expanding cities where competition for land is intense. This includes factors such as environmental risks, protected green spaces, land values, in addition to social issues such as accessibility and segregation. It is readily apparent that planners face an enormous number of factors, domains and issues that interact with and feed back to one another in very complex ways.

To capture and address this complexity, planners use tools that include integrated urban models, for which there are a number of terms, such as land-use models and land-use transport interaction models. These models provide simplified representations of the real world, and can be used for studying the impact of various spatial planning policies in a systematic way. A typical integrated urban model allocates predicted numbers of houses and work-places spatially according to a specific planning policy, thereby creating a new urban landscape. Because one very important consequence of a new urban configuration is the change that can be expected in terms in travel behaviour, these urban models consider transport issues either by considering them in conjunction with a transport model or by integrating the two themes into a single model. The consequences of the future allocations can then be quantified in a number of ways (e.g. future land consumption, loss of green spaces, or identification of land-use conflict areas).

An integrated modelling system provides a number of parallel benefits to planners when they formulate strategic policy decisions. Apart from their explanatory role in understanding the dynamics of urban systems, they have a predictive role by enabling virtual experimentation of various development scenarios. This allows planners to visualise and measure the future impacts of different spatial planning strategies to determine which ones lead to the achievement of planning goals. Additionally, they can be used to stimulate thinking and to facilitate discussion, which means they are powerful tools to facilitate participatory processes of collaborative decision-making.

Thus, even though integrated urban models are NOT intended to provide definite or predictive statements about the future, they can be a very powerful tool-box to quantify several aspects of the complex urban system coherently and systematically, and to facilitate the design and assessment of appropriate plans and policies for green growth. That said, Nordregio's and WSP's joint review of the use of these tools in the Nordic countries shows minimal use of such models despite a strong tradition of comprehensive planning in the Nordic region. Given that these organisations cite a lack of understanding of the availability and benefits of integrated models as the main reason for not using them, it is clear that more convincing information on the use and benefits of such models is required. This is particularly true for those integrated models that are easy to apply, relatively inexpensive, and proven to provide realistic and insightful outputs that foster deliberation within participatory planning processes.

#### Further reading

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# Sustainability Certification of Neighbourhoods: Experience from DGNB New Urban Districts in Denmark

*By Jesper Ole Jensen*

With increasing urbanization and political ambitions to reduce the environmental impact of cities, urban leaders are faced with immense challenges. The pursuit of CO2 reduction has left other sustainability targets somehow overlooked, but not less relevant. This includes environmental issues such as water supply, management of rainwater, transport and the localization and production/protection of green areas. It also includes social sustainability issues such as how to ensure a balanced mix of both residential and other land uses, how to integrate meeting places in the city and to allow a sharing of facilities. Important economic issues also include considerations of how an urban development influences the city economy. One planning tool that has recently emerged to help planners balance these sustainability issues is neighbourhood certification schemes, including the DGNB<sup>1</sup> New Urban Districts certification scheme.

This article describes the first steps in testing and implementing the DGNB New Urban Districts certification scheme for sustainable urban neighbourhoods in Denmark. The certification scheme assesses the degree of sustainability of a neighbourhood, and rewards those neighbourhoods with a gold, silver or bronze rating. Ideally, such visualization of area-based sustainability can provide different actors with important information about the area. For municipalities and developers it can be a way to visualize, maximize and prioritize various sustainability issues; for investors it can provide assurance that the area holds a certain sustainability standard, making it attractive for future investments. The certification aims at making sustainability explicit and allows for consistent benchmarking across areas, making it clearer what is meant when a neighbourhood development plan is labelled 'sustainable'.

## From buildings to neighbourhoods

Using a certification scheme for assessing the sustainability of entire neighbourhoods is relatively new in Denmark as well as in the rest of Scandinavia. It can be seen as a direct development of the tools



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<sup>1</sup> *Deutsche Gesellschaft für Nachhaltiges Bauen* [www.dgnb.de](http://www.dgnb.de) (German Society for Sustainable Building)



used for assessing the sustainability of buildings, which were developed through the 1980s and 1990s, many of which are currently being used internationally and in the Scandinavian countries. In recent years, international building assessment tools such as BREEAM (U.K.) and LEED (U.S.) have developed their own version of Neighbourhood Sustainability Assessment (NSA): BREEAM Communities and LEED-ND (Leadership in Energy and Environmental Design for Neighbourhood Development). Tools for NSA also exist, including CASBEE-UD (Comprehensive Assessment System for Building Environmental Efficiency for Urban Development) in Japan, and Green Star Communities in Australia. The majority of these NSA tools can be categorized as 'spin-off tools' (Sharif & Murayama, 2012), meaning that they stem from third-party building certification schemes.

In Denmark, as well as in other Scandinavian countries, there has been an increasing interest in using international certification schemes for buildings and neighbourhoods as a supplement to national building regulations. Instead of developing national schemes, Denmark and Sweden have utilized existing international certification schemes after forming national Green Building Councils. The Danish Green Building Council decided to use the German DGNB certification tool for buildings and neighbourhoods, in competition with LEED, BREEAM and the French HQE, because it is the newest scheme, and therefore reflects the latest European standards for sustainability assessment. DGNB also prioritizes all three sustainability aspects— social, economic and environmental – but most importantly, it includes the possibility of developing a locally adapted version for the Danish context, which would not have been possible with LEED or BREEAM.

## **DGNB**

The DGNB New Urban Districts scheme assesses the neighbourhood on five parameters: environmental quality, economic quality, socio-cultural and functional quality, technical quality and process quality. These are divided into subgroups that include a number of different evaluation parameters, e.g., the amount and quality of public spaces and 'placemaking' in the area, the area's contribution to the municipal economy, the involvement of local actors in the development plan, the social and functional mix in the area and many others. Each of the parameters has different weights, leading to a total score (as a percentage) that defines the grade of sustainability (see Figure 1). The certification can also be conducted at three different stages of the development cycle, as shown in Figure 2.

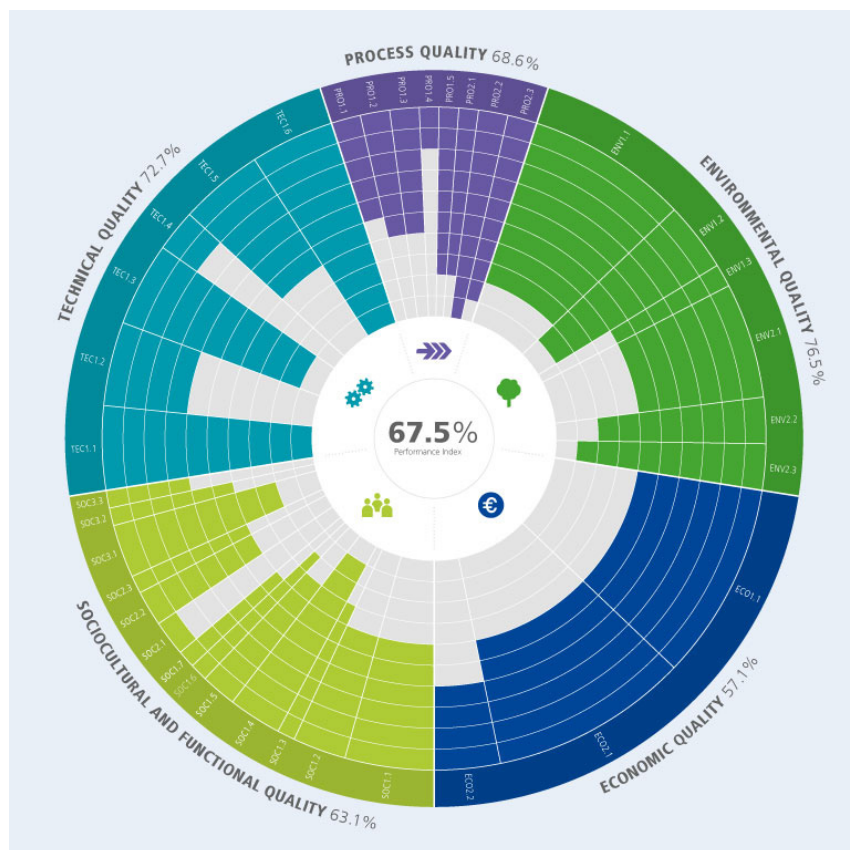


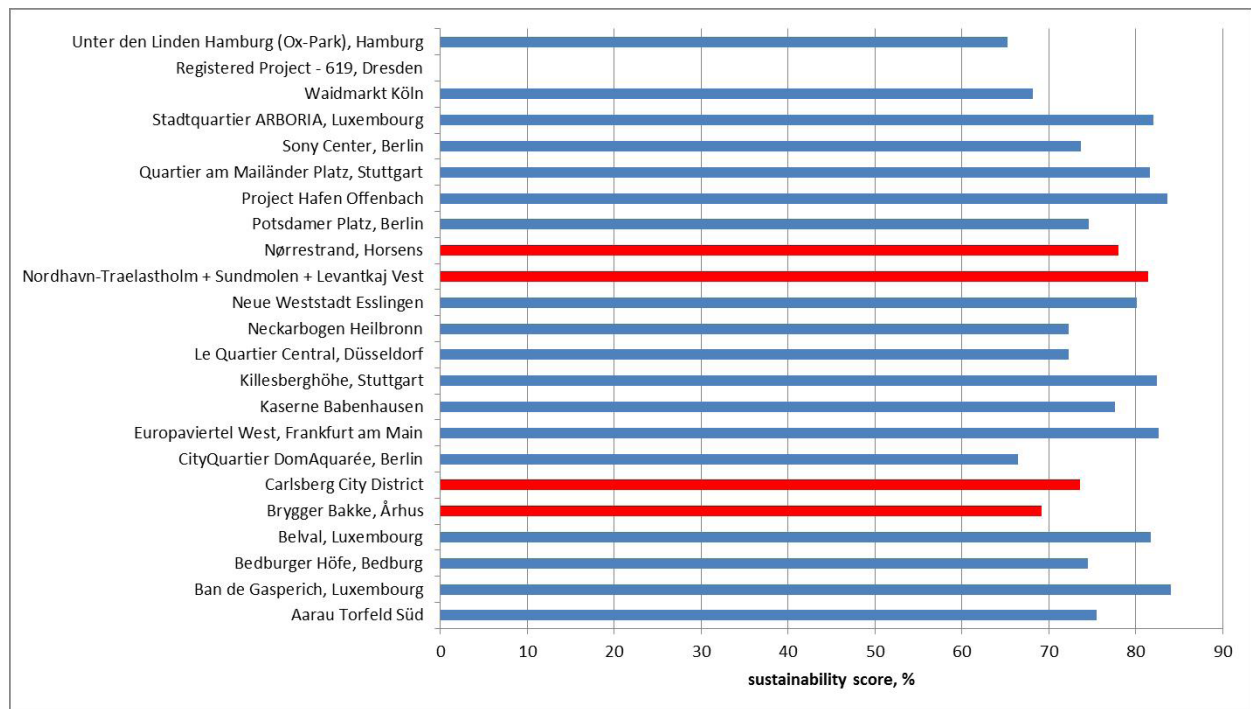
Figure 1. The DGNB Urban Districts scoring system.



Figure 2. Certification at various stages of the development process.

## The Danish experience

The adaptation of DGNB New Urban Districts in Denmark consists of two stages: a) a pilot test of the original criteria in four development areas, and b) a process of adapting the criteria to a Danish context. In the pilot test, the German criteria from the DGNB New Urban Districts were used directly in four development areas. Table 1 outlines the main characteristics of the areas and the results of certification. In figure 3 the scores are illustrated in comparison with the other projects having received a sustainability certification through DGNB New Urban Districts. The four areas have been pre-qualified and they are all long-term development areas, with a time horizon of 10–30 years before being fully developed.



**Figure 3.** Sustainability scores for the 23 urban districts with a DGNB certificate (at 28.11.2013), including the four Danish projects (in red).

Name	Type and owner	Area	Strengths Examples of high scores	Weaknesses Examples of low scores	Grade
<b>Nørrestrand, Horsens</b>	Greenfield development Private landowner	33 ha 1,200 inhabitants 85,000 m <sup>2</sup> floor area 224 low-energy housing units	<ul style="list-style-type: none"> <li>Water and soil protection</li> <li>Resource-efficient infrastructure</li> <li>Open spaces</li> </ul>	<ul style="list-style-type: none"> <li>Land use (greenfield)</li> <li>Quality of public transport</li> </ul>	Silver
<b>Nordhavnen, Copenhagen (Trælastholm, Sundmolen and Levantkaj Vest)</b>	Brownfield development By & Havn	26 ha 115,000 m <sup>2</sup> housing 160,000 m <sup>2</sup> offices	<ul style="list-style-type: none"> <li>Microclimate: directly on sea-front</li> <li>Economic: fiscal effects on the municipality</li> <li>Public transport: metro stop</li> <li>Sustainability reporting</li> </ul>	<ul style="list-style-type: none"> <li>No art in public spaces</li> <li>Construction site and process</li> <li>No local food production</li> </ul>	Gold
<b>Carlsberg City District, Copenhagen (brownfield)</b>	Brownfield development Carlsberg Byen P/S	25 ha 567,000 m <sup>2</sup> 3,000 housing units	<ul style="list-style-type: none"> <li>Social and commercial infrastructure</li> <li>Reuse of existing buildings</li> </ul>	<ul style="list-style-type: none"> <li>Water and soil protection being a former industrial site</li> <li>Rainwater management</li> </ul>	Silver
<b>Brygger Bakke, Århus</b>	Brownfield development The municipality of Århus, Domis A/S and three smaller companies	13 ha 125,000 m <sup>2</sup> buildings 1,000 housing units	<ul style="list-style-type: none"> <li>Compact development</li> <li>Holistic energy concept</li> </ul>	<ul style="list-style-type: none"> <li>No local food production</li> <li>Noise from surrounding traffic</li> </ul>	Silver

**Table 1.** The four Danish test areas for DGNB Urban Districts certification

Certification has led to only limited changes in the lay-out and design of the areas, because most of the four areas were planned before they entered the certification process. Instead, it has mainly been used to document the degree of sustainability of the projects and highlight strengths and weaknesses in their respective sustainability concepts (Table 1).

The users of DGNB have evaluated the process and highlighted different pros and cons of the system. The main dilemma concerns the high degree of details in data documentation, which increases credibility and legitimacy but also requires significant resources (typically 30–40 days for the auditor of each area); this makes it difficult to provide a concise and transparent overview of scores, particularly to those actors who are not familiar with the scheme. The scheme's ambition to encompass both breadth and depth of sustainability issues is also seen as a somewhat different approach from development plans, where typically a limited number of sustainability issues are highlighted.

During the second stage of the process, taking place from early 2014, the DGNB criteria will be adapted to the Danish context. The work will be carried out by a number of volunteer experts (consultants, researchers, municipal planners, etc.) working in groups on different themes. The process of discussing and adapting each of the DGNB criteria to a Danish context will potentially make the DGNB New Urban District scheme a condensed collection of knowledge and best practice on urban sustainability in Denmark, thereby serving not only as a certification tool, but also as a reference tool for future sustainable urban development.

## Perspectives

The idea of sustainability certification is a promising planning tool to aid the development of sustainable cities but it is too early to say what future role the DGNB New Urban District scheme will have in Denmark. The pilot test of the four areas provides a picture of a systematic but also rather resource-intensive tool. However, the final adaptation process is an opportunity to make the criteria and the process leaner, allowing for closer integration with existing planning procedures. Furthermore, an increasing diffusion into the market will make relevant actors more familiar with the system, and enable an earlier adaptation of the criteria in the planning process and thereby a smoother integration.

International experience with LEED-ND and BREEAM Communities shows that institutional support and encouragement from central and local authorities to use the tool have been important for diffusion. For example, some local authorities in the U.K. demand BREEAM Communities certification in all major developments in the municipality (Sharif and Murayama, 2012). With the pilot tests completed, and the final adaptation process to take place, there will be many opportunities to look for ways to integrate the certification criteria in existing legislation, regulation and practices for sustainable urban development.

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Danish Green Building Council'  
[www.dk-gbc.dk](http://www.dk-gbc.dk)

DGNB Germany [www.dgnb.de](http://www.dgnb.de)



# Urban Planning and Big Data – Taking LUTi Models to the Next Level?

*By Joan Serras, Melanie Bosredon, Ricardo Herranz & Michael Batty*

Cities are growing very rapidly worldwide. This growth entails many challenges which cut across different city layers. In terms of demography, we are facing many issues to do with migration and aging of the population. In terms of land use, a big challenge involves how we deal with congestion in terms of high densities and sprawl in cities and also how we can tackle segregation so that we might decrease inequality and deprivation. The availability of resources is of concern in terms of how efficiently and sustainably we use energy. The transport sector faces big tests with respect to congestion in infrastructure across all travel modes, growing levels of pollution and noise, and accidents. To add to the complexity of the challenges just mentioned, they span different spatial and temporal scales as well.

Urban planners need to somehow juggle these issues through the use of a variety of tools. One of these tools is the so called Land Use Transport interaction (LUTi) model. This is really a family of models that aim to estimate how cities will develop on a long term basis (typically over a period of 30 to 50 years) through the interaction of three main factors: population, land use and transport services. Among the many processes addressed by LUTi models, the main one is perhaps the interplay and feedback of information from the land use system to the transport system and vice versa. This reflects the influence of land use patterns on mobility patterns and the evolution of transport infrastructure in one direction, and in the other direction, how transport systems have an impact on how urban form evolves and how people engage in various land use activities. Typical plans evaluated using this family of models include the estimation of the impacts around a change in transport infrastructure, e.g. a new railway line between two areas, or the building of a new development in the region, e.g. a new industrial estate. This would include economic impacts (regional and/or national), often disaggregated by industrial sectors; and the prediction of diverse data on households, population (by type) and the number of additional jobs for each of the modelled areas.

To gain a better understanding of where urban models might be going in the future, we will first have a look at where they come from and how they have evolved over the years ([Wegener, 2010<sup>1</sup>](#) and [EUNOIA position paper<sup>2</sup>](#)).



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## Historical background

There was a first surge of LUTi models during the 1960s in the US which lasted until the mid 1970s. The main difficulties around this first family of urban models were synthesised by Lee in his *Requiem for large-scale models* article in 1973 where he listed ‘seven sins’ of the models from this period: hypercomprehensiveness, grossness, hungriness, wrongheadedness, complicatedness, mechanicalness and expensiveness. This was the rhetoric of those times and in essence, the models did not match up to the intellectual and policy needs for effective forecasting and they were difficult to implement due to limits on data and computer resources. It is therefore not surprising that these kinds of urban model were then more or less abandoned during the late 1970s and 1980s.

However, advances in computing, the birth of Geographic Information Systems (GIS) and better data led to a second surge of urban models during the 1990s. New models advanced from previous implementations by further disaggregating zonal components and also population and employment groups using socio-economic attributes. New modelling techniques were explored, such as discrete choice theory and agent-based modelling. Another important factor was visualisation, which made results more interpretable and thus clearer to wider audiences. In particular, this includes better usability for planning practitioners through what have come to be called planning support systems (PSS). These improvements were further supported in the US and the EU by specific initiatives, which meant that many of these models ended up being applied in an increasing number of cities.

Perhaps the most important advance in recent years has been the adoption of new modelling approaches - amongst which activity-based modelling and microsimulation transport modelling are particularly exciting. At the same time, our evolving knowledge around model development continues to challenge the limits of model computation, which means we are also observing an increasing trend on the parallelisation of processes to run models. Simply put, the sheer amount of calculations within such models, with constant feedback loops from sub-models to other sub-models, means that multiple models are being integrated together in new ways.

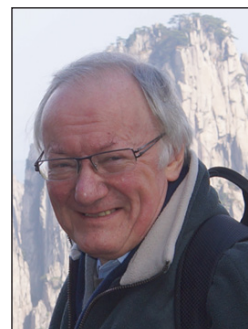
## Big Data and urban models - The EUNOIA project

Understandably, the Big Data era, where information relevant to urban planning is starting to be available from unconventional sources, has brought integrated urban models back into the spotlight. Data based on crowd-sourcing, remote sensing, online social networking, smart transit ticketing, mobile phone usage and credit card transactions have a common denominator: they all contain geo-located information. As a result, we are moving from structured, static, demographic and economic activity data (e.g. census data) to unstructured, dynamic data able to provide new insights about urban dynamics.



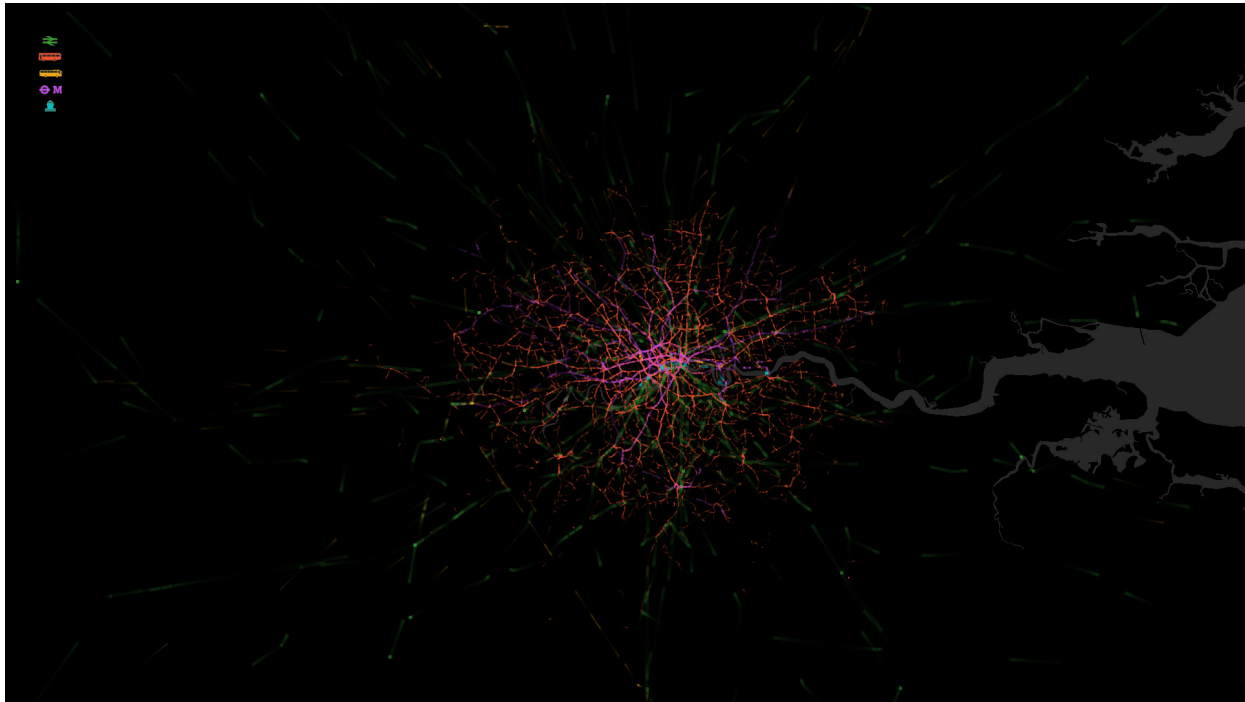
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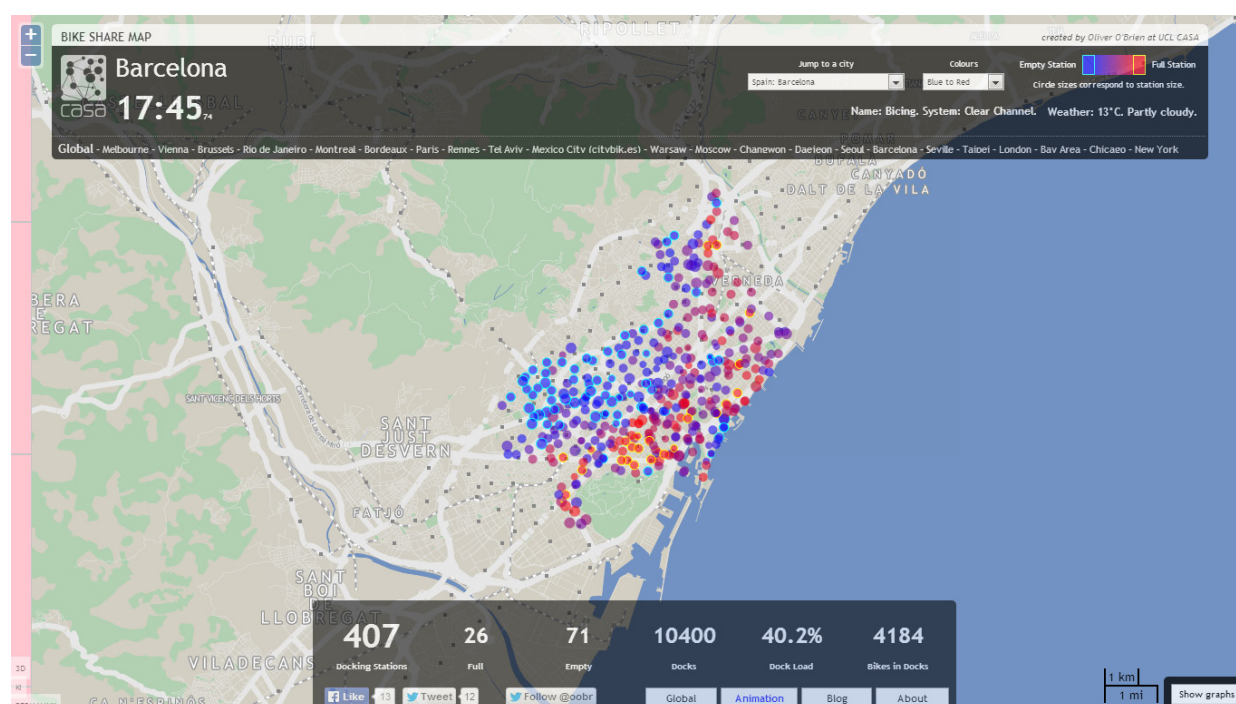
**Figure 1.** Snapshot of public transport services operating in London on a typical working day at 8:30am. Travel modes are colour coded: rail services in green, bus services in red, coach services (longer range bus service) in yellow, metro services in violet and ferry services in blue. For more information on the visualisation: <http://simulacra.blogs.casa.ucl.ac.uk/2011/03/visualising-public-transport-networks/>.

While the potential of the data is huge, it also comes with many hurdles. We have more data, but often with lower explanatory power about the underlying decisions and behaviours of city users. Another important issue around some of these data types which is very relevant to us as urban modellers is its ‘representativity’ in our case study areas. In this sense, we are just starting to learn how to cope with this huge paradigm shift. In the past, behavioural patterns in the population data used in urban models were deduced using 1% population sample surveys (or similar values). From many of these new datasets we have now a much higher coverage, which can reach 40% or 50% of the population - but this sample size often comes at the expense of low quality, noisy or biased data. Data mining and the ability to blend data from multiple sources are becoming increasingly important for the identification of biases and inconsistencies in what can be quite gigantic datasets where billions of records are commonplace. Computational science enables us to process such data faster and new kinds of statistics based on data mining are essential for its analysis.

To make matters more complicated, the very same technologies which allow us to collect and use all this data have a much more important impact: research suggests that ICT is changing the way we live. Or, in other words, our daily activities in their various purposes (work, shopping, leisure or education to name a few) are being affected by the way we interact with our surroundings through ICT. Not just in the way we plan them but also in the way we get to interact with them

and experience them. Urban models face a big challenge in capturing these behavioural changes.

EUNOIA is a European research project that investigates how data from multiple sources available in the context of the Big Data and the smart city movement (including data from smart cards, mobile phone traces, online social networks or credit cards, among others) can be integrated, analysed and visualised to understand mobility and location patterns in cities. New data sources can be used to replace or augment traditional data collection methods, but also to inform and enable the development of new modelling approaches. These in turn support researchers and practitioners with new insights about how city users live and move about in cities. Mobile phone data can be used to obtain origin-destination matrices at a much lower cost than from traditional household travel surveys, or can be combined with surveys to provide a richest pool of data. Data on credit card usage provides very rich information on expenditure flows across the city which can be used to formulate, calibrate and validate retail location models. Online social networks can be used to investigate the role of social interaction on mobility. The list is endless, and its exploration is still a largely unknown domain.



**Figure 2.** Snapshot of occupancy in bike share stations in Barcelona on the 14th of January 2014 (courtesy of Oliver O'Brien). See the live web application here: <http://bikes.oobrien.com/global.php>

EUNOIA is looking at these and other questions with the aim of developing improved models and integrating them into large-scale, state-of-the art urban simulation tools, such as the agent-based transport simulation framework MATSim or the more aggregated LUTi framework **SIMULACRA**<sup>3</sup>. The project also aims at developing user-friendly visual interfaces and data representations enabling analytical reasoning and interpretation of the simulation results. A number of case studies, defined in collaboration with planning authorities and mobility stakeholders from the three cities participating in the project (Barcelona, London, and Zurich) are aimed at evaluating the potential of the newly developed tools to address relevant policy questions, such as the planning and operation of the bike sharing systems in London or Barcelona.

### **Closing statements**

Urban models have become a useful tool for planners to tackle many of the problems around the growth of cities. These models are now over 40 years old which means they have gone through many re-evaluations to improve their accuracy. Having said that, urban models still face many challenges ahead. We will emphasise four of them. First, they require a lot of computer processing power, especially regarding transport modelling. Fast and yet realistic implementations need to be sought to enable various model runs using shorter times. Second, the visual interface showing the results of LUTi models still has much room for improvement. More interactive and comprehensive tools to understand the results need to be implemented to help practitioners and other stakeholders. Third, there has been some discussion in the modelling community around the concept of dynamic versus static model implementations. As discussed by **Ying and Wegener**<sup>4</sup>, this is a very challenging topic as it points to the core of the model design in order to better capture a world whose equilibrium is most likely dynamic. Finally, and perhaps most relevant in the context of our current research in EUNOIA, we need to find out whether more representative samples such as the ones from big data lead to potential advances in urban modelling. We believe breakthroughs in any of these areas will allow urban planners to be in a better position to tackle many of the challenges that cities are currently facing.

<sup>1</sup> [http://www.spiekermann-wegener.com/pub/pdf/MW\\_WCTR2010\\_01651.pdf](http://www.spiekermann-wegener.com/pub/pdf/MW_WCTR2010_01651.pdf)

<sup>2</sup> [http://eunoia-project.eu/media/uploads/pdf/eunoia\\_positionpaper\\_oct2012.pdf](http://eunoia-project.eu/media/uploads/pdf/eunoia_positionpaper_oct2012.pdf)

<sup>3</sup> <http://www.envplan.com/abstract.cgi?id=b4006mb>

<sup>4</sup> <http://www.envplan.com/abstract.cgi?id=b4006ge>